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मानक

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IS 1528-1 (2010): METHODS OF SAMPLING AND PHYSICAL TESTS FOR REFRACTORY MATERIALS, Part 1: DETERMINATION OF PYROMETRIC CONE EQUIVALENT (PCE) OR SOFTENING POINT [MTD 15: Refractories]



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भारतीय मानक
उष्मासह सामग्रियों के नमूनें लेने की और भौतिक परीक्षण पद्धतियाँ
भाग 1 उल्तापमिति शंकु समतुल्य (पी सी ई) या गलन बिंदु का निर्धारण
(तीसरा पुनरीक्षण)

Indian Standard

**METHODS OF SAMPLING AND PHYSICAL TESTS
FOR REFRACTORY MATERIALS**

**PART 1 DETERMINATION OF PYROMETRIC CONE EQUIVALENT
(PCE) OR SOFTENING POINT**

(Third Revision)

ICS 81.080

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

FOREWORD

This Indian Standard (Part 1) (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Refractories Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1953 and subsequently revised in 1974 and 1980. This standard deals with the determination of pyrometric cone equivalent (PCE) or softening point. Other parts in this series are:

- Part 2 Determination of refractoriness under load
- Part 3 Determination of spalling resistance
- Part 4 Determination of cold crushing strength
- Part 5 Method for determination of modulus of rupture at ambient temperature of dense and insulating shaped refractory products
- Part 6 Determination of permanent linear change after reheating for shaped insulating and dense refractories
- Part 7 Methods of sampling and criteria for conformity
- Part 8 Determination of apparent porosity
- Part 9 Determination and true density
- Part 10 Determination of size of refractory bricks
- Part 11 Determination of warpage
- Part 12 Method for determination of bulk density and true porosity of shaped insulating refractory products
- Part 13 Determination of resistance to carbon monoxide
- Part 14 Determination of sieve analysis
- Part 15 Method for determination of bulk density, apparent porosity and true porosity of dense shaped refractory products
- Part 16 Determination of thermal conductivity according to hot-wire method (parallel)
- Part 17 Determination of cold crushing strength of shaped insulating refractory products
- Part 18 Determination of creep in compression
- Part 19 Determination of thermal expansion
- Part 20 Determination of modulus of rupture at elevated temperature
- Part 21 Determination of thermal conductivity according to hot-wire method (cross-array)
- Part 22 Methods for determination of permeability to gases of dense shaped refractory products

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

METHODS OF SAMPLING AND PHYSICAL TESTS FOR REFRACTORY MATERIALS

PART 1 DETERMINATION OF PYROMETRIC CONE EQUIVALENT (PCE) OR SOFTENING POINT

(*Third Revision*)

1 SCOPE

This standard (Part 1) prescribes the method for determination of pyrometric cone equivalent (PCE) or softening point of refractory materials.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
1528 (Part 7): 2010	Methods of sampling and physical tests for refractory materials: Part 7 Methods of sampling and criteria for conformity (<i>second revision</i>)
4041 : 2006	Terminology for refractories (<i>first revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 4041 shall apply.

4 DETERMINATION OF PYROMETRIC CONE EQUIVALENT (PCE) OR SOFTENING POINT

4.1 Object of Test

The object of this test is to determine the softening point of refractory materials by comparing the test cones prepared from the refractory material under test with standard pyrometric cones.

4.2 Heating Furnace

A furnace of the type in which a neutral or oxidizing atmosphere may be maintained shall be preferred.

4.3 Preparation of Samples

4.3.1 Raw Materials

Test pieces prepared from raw materials that are subject to considerable modification during reheating shall then be stabilized by heating before their refractoriness is determined. In particular, clays should be calcined at approximately 1 000°C; after calcination, the test pieces shall comply with the requirements of 4.4.2.

4.3.2 Fired Shapes

Take 1 kg of the material. In the case of bricks or shapes, obtain a composite sample from bricks or portions of a number of test pieces taken for other tests, and reduce these fragments in size by means of rolls or jaw crusher adjusted to pass lumps not greater than 5 mm in diameter; take precautions to prevent contamination of the sample with steel particles during crushing or grinding. Reduce the quantity through quartering by different stages of grinding to about 50 g as test sample. Grind the full quantity of the material to pass through 212 micron IS Sieve by suitable grinder or agate mortar. Magnet should be used to separate the iron particles introduced during grinding and crushing operations except in the case of materials, which are themselves magnetic. In order to avoid excessive reduction of the fines, remove them frequently during the process of reduction by throwing the sample on the sieve and continue grinding of coarser particles until all the sample passes through the sieve. Subsequently make specimen as specified in 4.4.1.

4.3.3 For Dry Monolithic Materials

Samples of unshaped materials, such as, plastic refractories, ramming materials and refractory cement shall be shaped and fired in a manner appropriate to the material and its condition of use; the firing temperature shall be stated in the test report.

4.3.4 For Mortar make specimen as per dry monolithic

materials and add the liquid component, if any, in appropriate proportion. Subsequently make specimen as specified in 4.4.1.

NOTE — At all states, crushing and grinding should be carried out so as to avoid the introduction of extraneous material. At all stages, mixing should be carefully carried out so that the contents of the test pieces are truly representative of the samples.

4.4 Preparation of Test Cone

4.4.1 Moulding

Mix thoroughly the sample prepared under 4.3.2 and after adding sufficient alkali free dextrin or glue and water, form into test cones in a metal mould, preferably of brass, in the shape of tetrahedron measuring 8 mm on the sides of the base, and 25 mm high (see Fig. 1).

4.4.2 Sintering

When dry, subject the test cones, if necessary, to a preliminary burn at a temperature not exceeding 1 000°C for the purpose of sintering them into a firm condition to permit handling.

4.5 Procedure

4.5.1 Mount the test cones and the standard pyrometric cones, the feature of typical standard cones used are reported in Table 1, on a plaque with

the help of bonding material. Both the plaque and the bonding material should be of such composition, which will not affect the fusibility of the cones.

4.5.2 Mount the cones with the base embedded approximately 3 mm deep in the plaque, and one of the faces inclined towards the centre of plaque and at an angle of 82° with the horizontal. Arrange the test cones around the outer edge of the plaque with standard cones in between them in the anticipated range, as far as practicable (see Fig. 2).

4.5.3 Place the test plaque with the test pieces and the pyrometric reference cones attached to it in the uniform temperature zone of the furnace. Avoid reducing conditions in the furnace during heating. Take care that the flame does not strike directly against the cones or the cone plaque. Check the furnace at intervals for uniformity of distribution of heat.

4.5.4 Over a period of 1.5 to 2 h, raise the temperature of the furnace to 200°C below the estimated refractoriness temperature of the test material.

4.5.5 Raise the temperature at the rate of 2.5°C/min or at the rate specified by the manufacturer of the cones. Maintain the heating so that at any moment the deviation from the specified temperature rise curve is less than 10°C.

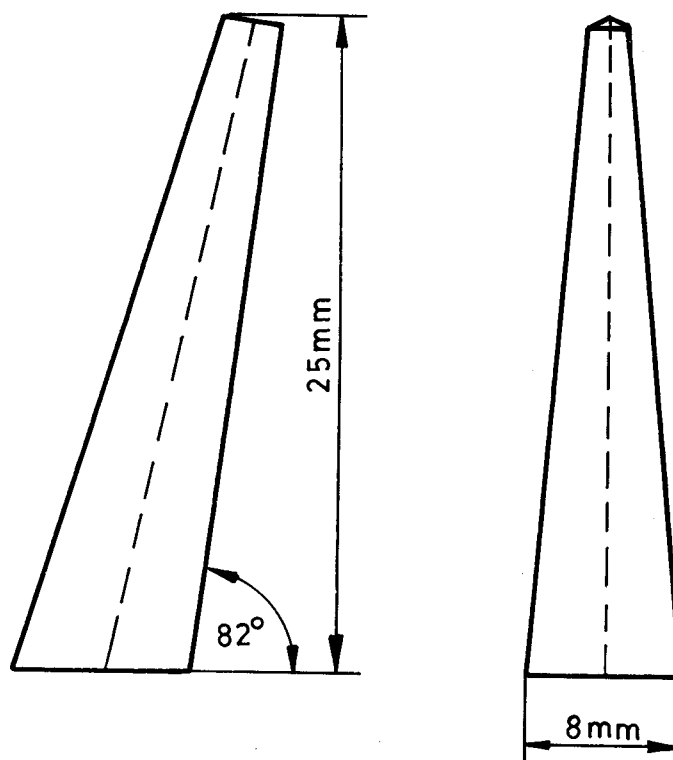


FIG. 1 STANDARD PYROMETRIC TEST CONE

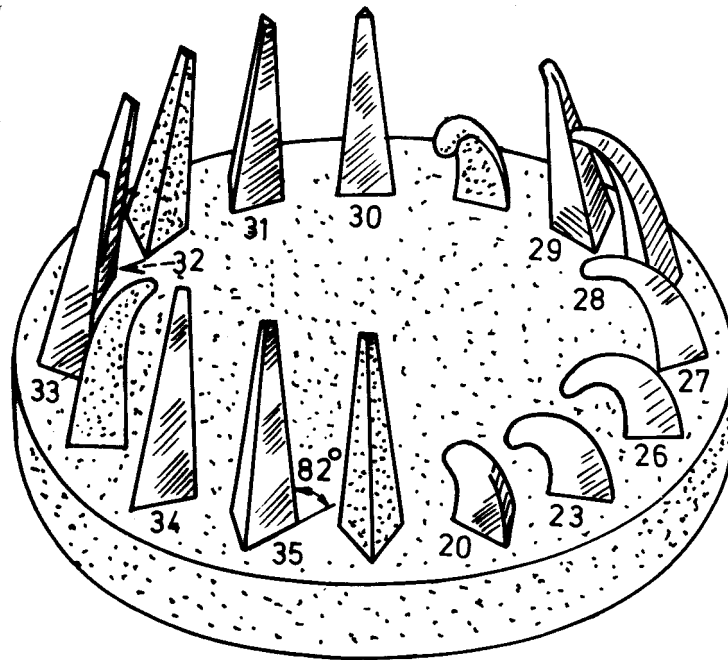


FIG. 2 METHOD OF MOUNTING TEST CONE AND APPEARANCE AFTER TESTING

4.6 Softening Point

Softening of the cone will be indicated by the top bending over and the tip of the cone touching the plaque surface.

4.7 Report of Results

4.7.1 Report the softening point in terms of the standard pyrometric cone, it being that cone which most nearly corresponds in time of softening with the test cone.

4.7.2 If the test cone softens later than one cone but earlier than the next cone and approximately

midway between, report the softening point, for example, Cone Number 31-32.

4.7.3 If the test cone starts bending at an early cone but it is not down until a later cone, report the fact.

4.8 Standard Cone Data

The standard pyrometric cone equivalents of standard cones are given in Table 1.

5 SAMPLING AND CRITERIA FOR CONFORMITY

The procedure for sampling and the criteria for conformity shall be as laid down in IS 1528 (Part 7).

Table 1 Reference Temperature and Cone Designations

(Clauses 4.5.1 and 4.8)

SI No.	Cone Designation	Temperature °C	SI No.	Cone Designation	Temperature °C
(1)	(2)	(3)	(1)	(2)	(3)
i)	ISO 150	1 500	ix)	ISO 166	1 660
ii)	ISO 152	1 520	x)	ISO 168	1 680
iii)	ISO 154	1 540	xi)	ISO 170	1 700
iv)	ISO 156	1 560	xii)	ISO 172	1 720
v)	ISO 158	1 580	xiii)	ISO 174	1 740
vi)	ISO 160	1 600	xiv)	ISO 176	1 760
vii)	ISO 162	1 620	xv)	ISO 178	1 780
viii)	ISO 164	1 640	xvi)	ISO 180	1 800

NOTES

- 1 The end point temperatures reported in the table have been obtained from the respective manufacturers' catalogue.
- 2 Any standard cone is acceptable.

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Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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